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(71)出願人　000002255
昭和電線電纜株式会社
神奈川県川崎市川崎区小田栄２丁目１番１号

(72)発明者　出水屋　浩
神奈川県川崎市川崎区小田栄２丁目１番１号　昭和電線電纜株式会社内

(72)発明者　野口　賢治
神奈川県川崎市川崎区小田栄２丁目１番１号　昭和電線電纜株式会社内

(72)発明者　佐野　浩治
神奈川県川崎市川崎区小田栄２丁目１番１号　昭和電線電纜株式会社内

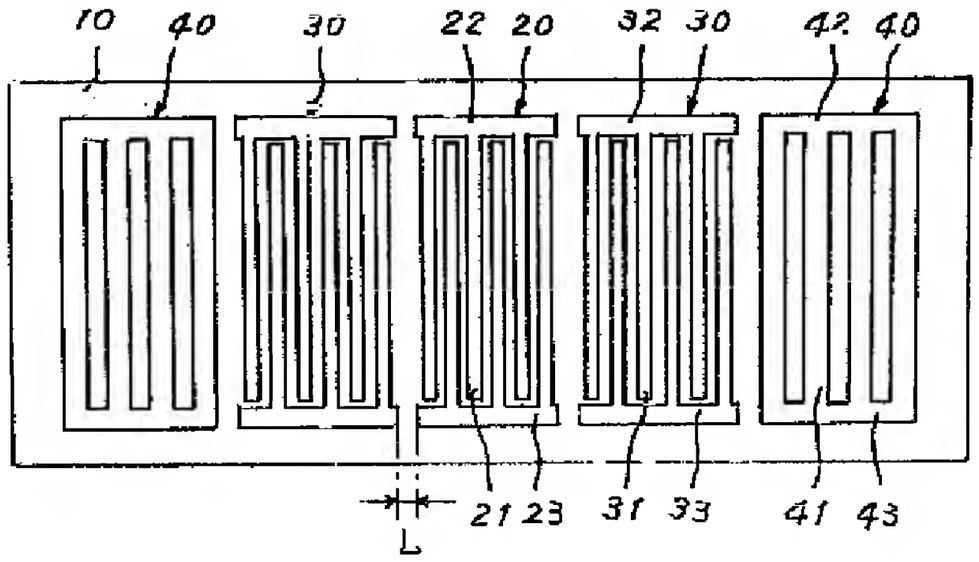
(74)代理人　弁理士　山田　明信

(54)【発明の名称】　共振器型ＳＡＷフィルタ

(57)【要約】

【課題】　通過帯域幅を広帯域化させると共にリップル成分を減少させ、設計の自由度を増加させたＳＡＷフィルタを提供する。

【解決手段】　圧電材料からなる基板の表面の中央部に第１の電極群を配し、その両側に第２の電極群を配し、これらの第２の電極群の両外側に第３の電極群を配した共振器型ＳＡＷフィルタにおいて、前記各電極群の電極指のピッチを異なる構成としたことを特徴とする。



【特許請求の範囲】
【請求項１】　圧電材料からなる基板の表面の中央部に第１の電極群を配し、その両側に第２の電極群を配し、これらの第２の電極群の両外側に第３の電極群を配した共振器型ＳＡＷフィルタにおいて、前記各電極群の電極指のピッチを異なる構成としたことを特徴とする共振器型ＳＡＷフィルタ。
【請求項２】　第２の電極群は並列接続されていることを特徴とする請求項１に記載の共振器型ＳＡＷフィルタ。
【請求項３】　第１の電極群および第２の電極群はスプリット電極構造であることを特徴とする請求項１または２に記載の共振器型ＳＡＷフィルタ。
【請求項４】　第２の電極群の中心周波数の波長をλとした場合、第１の電極群と、これに隣接する第２の電極群との電極間距離Ｌを０．５×λ～０．６×λとしたことを特徴とする請求項１ないし３のいずれか一項に記載の共振器型ＳＡＷフィルタ。
【請求項５】　第２の電極群の電極指のピッチＰＡを基準とした場合、第１の電極群の電極指のピッチＰＢを「０．９９６１６×ＰＡ～０．９９８７１×ＰＡ」とし、かつ第３の電極群の電極指のピッチＰＣを「０．９９２３４×ＰＡ～０．９９７４３×ＰＡ」に設定したことを特徴とする請求項１ないし４のいずれか一項に記載の共振器型ＳＡＷフィルタ。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、各種の通信用機器などで用いられる共振器型のＳＡＷフィルタ（弾性表面波フィルタ）において、挿入損失が小さく、かつ通過帯域幅を広帯域化させた共振器型ＳＡＷフィルタに関する。
【０００２】
【従来の技術】マイクロ波帯の各種の通信用機器や計測用機器などにおいては、圧電材料の表面に沿って伝搬する弾性波を利用した共振器型ＳＡＷフィルタが広く用いられている。一般に、共振器型ＳＡＷフィルタには、入力電極および出力電極が各１個で、それらの外側に２個の反射電極を配置したＡ型ＳＡＷフィルタと、入力電極が１個、出力電極が２個で、それらの外側に２個の反射電極を配置したＢ型ＳＡＷフィルタがある。Ａ型ＳＡＷフィルタとＢ型ＳＡＷフィルタとを比較すると、Ｂ型の方が挿入損失が小さく、結果的に搬送波対雑音比（Ｃ／Ｎ比）がよいことが知られている。また、通過帯域幅を広帯域化させたい場合には、各電極における電極指の対数を減らせばよいが、このようにすると、それに比例して挿入損失が大きくなるため、実用的でない。そこで、Ａ型ＳＡＷフィルタにおいては、特開平８－８６９０号公報などに示すように、入力電極と出力電極の電極指ピッチを異ならせることにより、広帯域化を図る試みがなされている。
【０００３】本特許出願人は、この技術を挿入損失の小さいＢ型ＳＡＷフィルタに適用することにつき検討を行ってきたが、所期の帯域特性を得ることはできなかった。すなわち、図２は、入力電極、出力電極および反射電極にソリッド電極を用いたＢ型ＳＡＷフィルタにおける挿入損失の周波数特性を示すもので、曲線１は各電極の電極指ピッチを全て等しくした場合の特性を示し、曲線２は入力電極と出力電極の電極指ピッチを異ならせた場合の特性を示す。この場合、中心周波数Ｆ０ は８０２ＭＨｚ、曲線１の帯域幅W1 は３．９２５ＭＨｚ、曲線２の帯域幅W2 は４．２４８ＭＨｚであった。このように、入力電極と出力電極の電極指ピッチを異ならせた場合には、周波数帯域幅は若干広がるが、その値は僅かであり、また通過帯域における遷移域と通過帯域を含むフィルタ特性が、中心周波数Ｆ０ を中心にして低域（Ｌ）側と高域（Ｈ）側とで非対称であることが分かった。したがって、入力電極と出力電極の電極指ピッチを異ならせただけでは十分な広帯域化を図ることは困難であり、設計の自由度が低いことが判明した。
【０００４】
【発明が解決しようとする課題】ＳＡＷフィルタとして理想的な特性は次の通りである。
（１）　挿入損失が小さく、かつ広帯域化できること。
（２）　遷移域と通過帯域を含むフィルタ特性が、中心周波数Ｆ０ を中心にして低域側と高域側とで対称であること。
（３）　通過帯域内の波形がフラット（リップルが少ない）であること。
（４）　実用的には設計の自由度が大きいこと。
本発明は、このような特性を満たす共振器型ＳＡＷフィルタを提供することを課題とするものである。
【０００５】
【課題を解決するための手段】本発明の共振器型ＳＡＷフィルタは、圧電材料からなる基板の表面の中央部に第１の電極群を配し、その両側に第２の電極群を配し、これらの第２の電極群の両外側に第３の電極群を配した共振器型ＳＡＷフィルタにおいて、前記各電極群の電極指のピッチを異なる構成としたことを特徴とする。
【０００６】
【発明の実施の形態】本発明において、基板としては、水晶、ニオブ酸リチウム、タンタル酸リチウムなどの圧電単結晶材料の他、各種の圧電セラミックス材料が使用される。これらの圧電材料からなる基板の表面にアルミニウムや金などの導電材料を蒸着し、これをフォトリソグラフィや電子線リソグラフィ、あるいはＸ線リソグラフィなどの手法を用いてエッチング加工し、入力電極、出力電極および反射電極を形成する。第１の電極群を入力電極に、第２の電極群を出力電極に、第３の電極群を反射電極にそれぞれ設定し、入力電極と出力電極は、弾

性表面波の進行方向と直交するようにそれぞれ並列配置した多数本の電極指と、それらを１本おき（ソリッド電極の場合）、または２本おき（スプリット電極の場合）に交互に連結した電極構造（すだれ電極）とすることができる。また、反射電極は、弾性表面波の進行方向と直交するようにそれぞれ並列配置した多数本の電極指のみ、あるいは各電極指とそれらの両端を短絡する短絡電極とから構成することができる。これらの場合、入力電極、出力電極および反射電極の各電極における電極指のピッチ、すなわちライン幅およびスペース幅は、各電極ごとに寸法を変えられ、中心周波数が異なるように設計される。なお、２個の反射電極における電極指のピッチと中心周波数は等しく設計される。

【０００７】本発明においては、請求項２に示すように、第２の電極群を並列接続しておくことにより、第１の電極群から両側に伝搬する弾性表面波を有効に利用することができ、ＳＡＷフィルタの挿入損失を半減させることができる。この場合、第２の電極群の電極指のピッチ（中心周波数）は互いに等しく設計されるのは勿論である。本発明においては、請求項３に示すように、第１の電極群と第２の電極群をそれぞれスプリット電極とすることができる。このようにすれば、通過帯域内におけるリップル成分を一段と減少させることができる。更に、請求項４に示すように、第２の電極群の中心周波数の波長をλとした場合、第１の電極群と、これらに隣接する第２の電極群との電極間距離Ｌを０．５×λ～０．６×λに設定すれば、フィルタ特性を一段と良好に保つことができる。　更にまた、請求項５に示すように、第２の電極群の電極指のピッチＰＡを基準とした場合、第１の電極群の電極指のピッチＰＢを「０．９９６１６×ＰＡ～０．９９８７１×ＰＡ」とし、かつ第３の電極群の電極指のピッチＰＣを「０．９９２３４×ＰＡ～０．９９７４３×ＰＡ」に設定すれば、フィルタ特性を一段と良好に保つことができる。

【０００８】

【実施例】以下、図面を参照して本発明の実施例を説明する。図１は、本発明のＳＡＷフィルタの実施例を概念的に示すもので、水晶やニオブ酸リチウムなどの基板１０の表面には、アルミニウムや金などの導電材料を真空蒸着し、これをフォトリソグラフィなどの手法によりすだれ状電極に加工し、第１の電極群として入力電極２０、第２の電極群として出力電極３０、および第３の電極群として反射電極４０がそれぞれ形成されている。基板１０の中央に形成された入力電極２０は、百数十対の電極指２１を、基板１０の長さ方向に直角方向にピッチ１．０４６μｍ程度の間隔で配列し、これらの電極指２１の各一端をバスバー電極２２，２３のいずれかに交互に連結した形状である。２個の出力電極３０は、入力電極２０の両側に等しい間隔Ｌをおいて配置されているが、これらの出力電極３０はそれぞれ百対程度の電極指３１を、基板１０の長さ方向に直角方向にピッチ１．０４８μｍ程度の間隔で配列し、これらの電極指３１の各一端をバスバー電極３２，３３のいずれかに交互に連結した形状である。

【０００９】２個の反射電極４０は、出力電極３０の両側に等しい間隔をおいて配置されているが、これらの反射電極４０は、それぞれ数十本程度の電極指４１を、基板１の長さ方向に直角方向にピッチ１μｍ程度の間隔で配列し、これらの電極指４１の両端を短絡電極４２，４３で短絡して構成されている。なお、上記において、電極指の対とは、一方のバスバー電極に連結された１本の電極指と、それに隣接し、他方のバスバー電極に連結された１本の電極指をもって一対と言い、また、電極指のピッチとは、電極指の幅を言うものとする。上述のように、本発明のＳＡＷフィルタは、入力電極２０、出力電極３０および反射電極４０の電極指のピッチを互いに異ならせており、これにより広帯域化が図られると共に、他の特性も向上している。すなわち、図３は上記実施例における特性を示すもので、同図中の曲線３と曲線１および曲線２（図２中の曲線１および曲線２と同じ）とを対比すれば明らかなように、曲線３の場合（入力電極２０、出力電極３０および反射電極４０の電極指のピッチを互いに異ならせた場合）には、帯域幅W3 は５．３２３ＭＨｚまで広帯域化されており、設計の自由度が大きくなっている。また遷移域と通過帯域を含むフィルタ特性が中心周波数Ｆ０（８０２ＭＨｚ）を中心にして低域側（Ｌ）と高域側（Ｈ）がほぼ対称波形になり、しかも曲線１や曲線２の場合に見られた低域側の遷移域Ｂは消失し、フィルタ特性が向上している。

【００１０】ところで、図１の実施例では、通過帯域内にかなりのリップルが見られる。この程度のリップルがあっても実用できる場合は多いが、リップルをより低減させることが要請される場合には、図４に示すように、入力電極２０および出力電極３０としてスプリット電極を使用するのがよい。この実施例においては、基板１０の中央に形成された入力電極２０は百数十対の電極指２１の各一端を２本おきにバスバー電極２２，２３のいずれかに交互に連結されており、入力電極２０の両側に等しい間隔をおいて配置された２個の出力電極３０は、それぞれ百対程度の電極指３１の各一端を２本おきにバスバー電極３２，３３のいずれかに交互に連結して構成されている。また、出力電極３０の両側に等しい間隔をおいて配置された２個の反射電極４０は、それぞれ数十本程度の電極指４１の両端を短絡電極４２，４３で短絡して構成されている。これらの入力電極２０と出力電極３０と反射電極４０は、電極指のピッチを電極毎に異ならせてある。因みに、図５中の曲線４は、入力電極２０、出力電極３０および反射電極４０の電極指のピッチを全て等しくし、入力電極２０と出力電極３０としてスプリット電極を用いた場合の特性を示すものであるが、この

場合には、通過帯域内の高周波側の肩（Ａ部分）が下がって帯域幅を狭くするため、帯域幅は５．４ＭＨｚ程度しかとれず、低周波側の遷移域（Ｂ部分）も歪んでいて、遮断特性は十分ではない。

【００１１】これに対して、上述のように電極指のピッチを電極毎に異ならせ、かつ入力電極２０と出力電極３０をスプリット電極で構成した共振器型ＳＡＷフィルタにおいては、図６の曲線５に示すように、通過帯域内におけるリップルが大幅に減少しており、また、高域側での落込みがなくなり、帯域幅も６．９ＭＨｚに拡大しており、低域側の遮断特性も改善されている。なお、図５および図６中における曲線６は入力電極の周波数特性を示し、曲線７は出力電極と反射電極を合わせた周波数特性を示している。上述のように、本発明によれば、通過帯域幅が広帯域化すると共に、遷移域の遮断特性も改善され、通過帯域内においても、リップル成分を減少させることができる。また、上記実施例のように、入力電極または出力電極の両側に出力電極または入力電極を１個ずつ配置した場合には、それらを並列接続することにより挿入損失を半減させることができる。

【００１２】ところで、図１や図４に示す共振器型ＳＡＷフィルタでは、入力電極（第１の電極群）２０と出力電極（第２の電極群）３０の電極指のピッチＰＢ，ＰＡが異なるため、フィルタ特性（出力波形）は、入力電極２０と出力電極３０との電極間距離Ｌに依存している。図７は出力電極３０の電極指のピッチＰＡ（中心周波数）の波長λに対して、入力電極２０と出力電極３０の電極間距離Ｌを、０．３×λ～０．７×λの範囲で変えた場合の特性を示すもので、曲線１は０．３×λの場合を、曲線２は０．５×λの場合を、曲線３は０．５５×λの場合を、曲線４は０．６×λの場合を、曲線５は０．７×λの場合を示す。これらの曲線群から明らかなように、曲線１の０．３×λと曲線５の０．７×λの時の特性は、通過帯域内のリップルが大きく不適であり、曲線２～４の０．４×λ～０．６×λの特性が好ましい範囲であると判断できる。

【００１３】図８と図９は、図１および図４に示す共振器型ＳＡＷフィルタの出力電極３０の電極指ピッチＰＡを基準に、入力電極２０の電極指のピッチＰＢと反射電極４０の電極指ピッチＰＣを変化させた場合の特性図である。図８の曲線１～５は出力電極３０の電極指ピッチＰＡに対して、入力電極２０の電極指のピッチＰＢを「１×ＰＡ～０．９９４８８×ＰＡ」の範囲で変化させた場合の特性を示すもので、曲線１（１×ＰＡ）と曲線５（０．９９４８８×ＰＡ）は通過帯域内のリップルが大きく不適であるが、曲線２～４（０．９９６１６×ＰＡ～０．９９８７１×ＰＡ）の範囲はリップルが小さく、好ましいことが分かる。また、図９の曲線１～５は出力電極３０の電極指ピッチＰＡに対して、反射電極４０の電極指のピッチＰＣを「１×ＰＡ～０．９８９８２×ＰＡ」の範囲で変化させた場合の特性を示すもので、曲線１（１×ＰＡ）と曲線５（０．９８９８２×ＰＡ）は通過帯域内のリップルが大きく不適であるが、曲線２～４（０．９９２３４×ＰＡ～０．９９７４３×ＰＡ）の範囲はリップルが小さく、好ましいことが分かる。

【００１４】なお、以上の説明においては、出力電極の中心周波数に対して、入力電極および反射器の中心周波数を若干増加させた例につき述べたが、本発明はこれに限定されるものではなく、出力電極に対して、入力電極および反射器の中心周波数を減少させてもよく、またそれらの増減の幅も上述の例に限定されないことは勿論である。また、本発明においては、各実施例における入力電極と出力電極を入替えても同様の特性を得ることができる。

【００１５】

【発明の効果】上述のように、本発明によれば、通過帯域幅が広帯域化すると共に、遷移域の遮断特性も改善され、また通過帯域内においても、リップル成分を減少させることができる。

【図面の簡単な説明】

【図１】　本発明の共振器型ＳＡＷフィルタの実施例を概念的に示す説明図。

【図２】　従来の共振器型ＳＡＷフィルタにおける挿入損失の周波数特性を例示するグラフ。

【図３】　図１の共振器型ＳＡＷフィルタにおける挿入損失の周波数特性を例示するグラフ。

【図４】　本発明の共振器型ＳＡＷフィルタの他の実施例を概念的に示す説明図。

【図５】　従来の共振器型ＳＡＷフィルタにおいて、入力電極と出力電極にスプリット電極を採用した場合の挿入損失の周波数特性を例示するグラフ。

【図６】　図４の共振器型ＳＡＷフィルタの挿入損失の周波数特性を例示するグラフ。

【図７】　共振器型ＳＡＷフィルタにおいて、入力電極と出力電極の電極間距離Ｌを変えた場合の挿入損失の周波数特性を例示するグラフ。

【図８】　共振器型ＳＡＷフィルタにおいて、出力電極の電極指ピッチＰＡに対して、入力電極の電極指のピッチＰＢを変化させた場合の挿入損失の周波数特性を例示するグラフ。

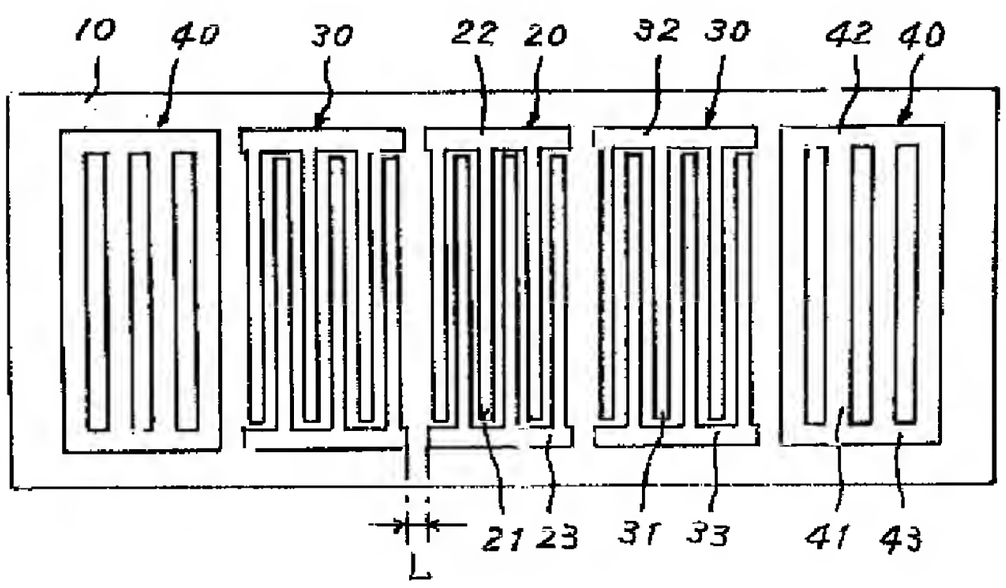
【図９】　共振器型ＳＡＷフィルタにおいて、出力電極の電極指ピッチＰＡに対して、反射電極の電極指のピッチＰＣを変化させた場合の挿入損失の周波数特性を例示するグラフ。

【符号の説明】

１０……基板
２０……入力電極
３０……出力電極
４０……反射電極
２１，３１，４１……電極指

２２，２３，３２，３３……バスバー電極　　４２，４３……短絡電極

【図１】



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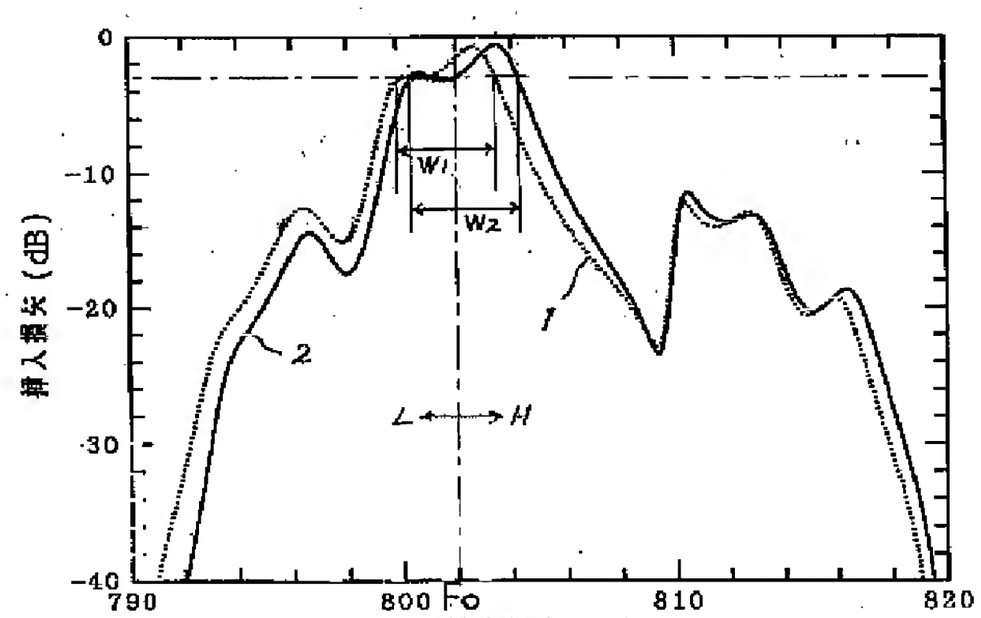

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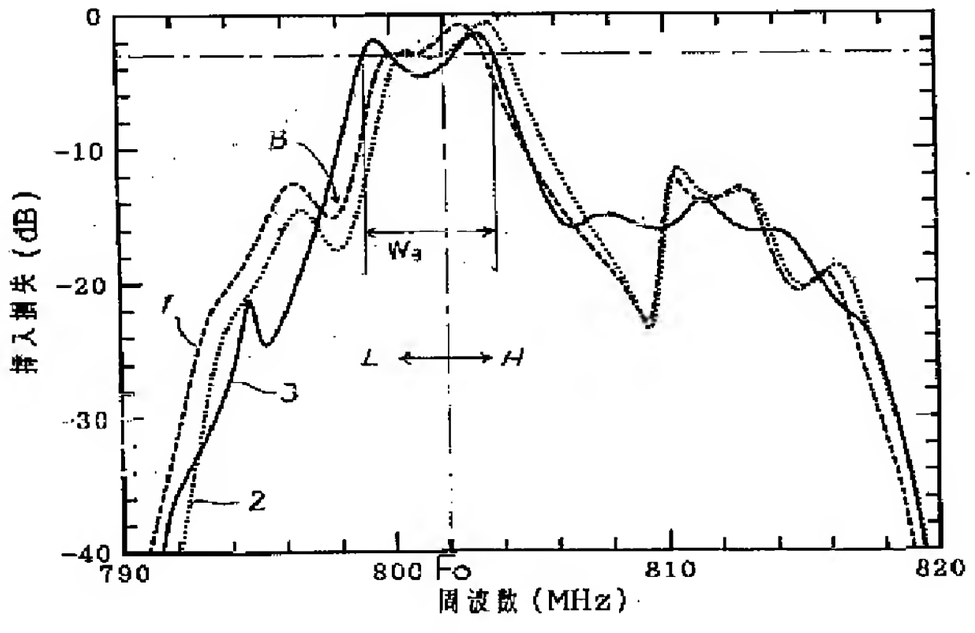

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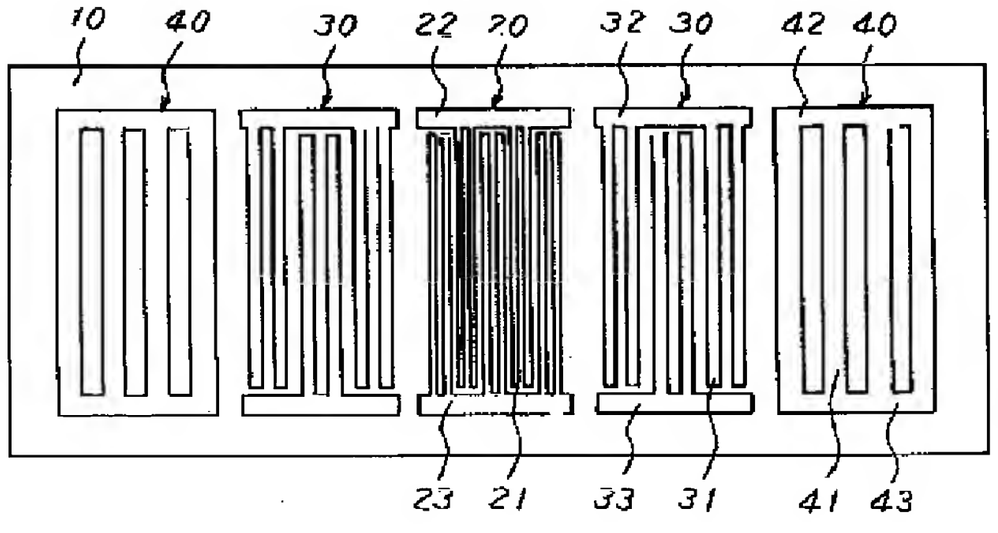

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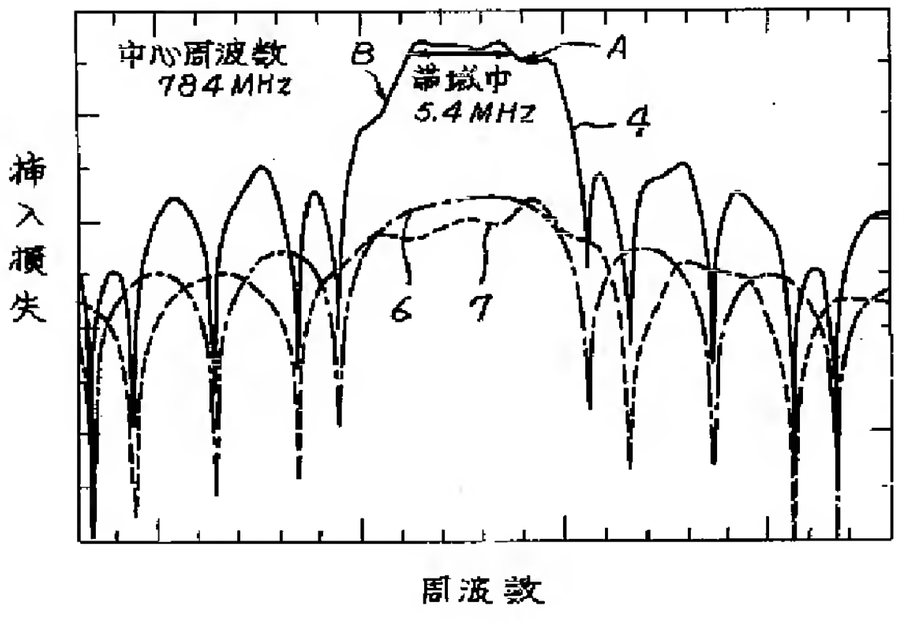

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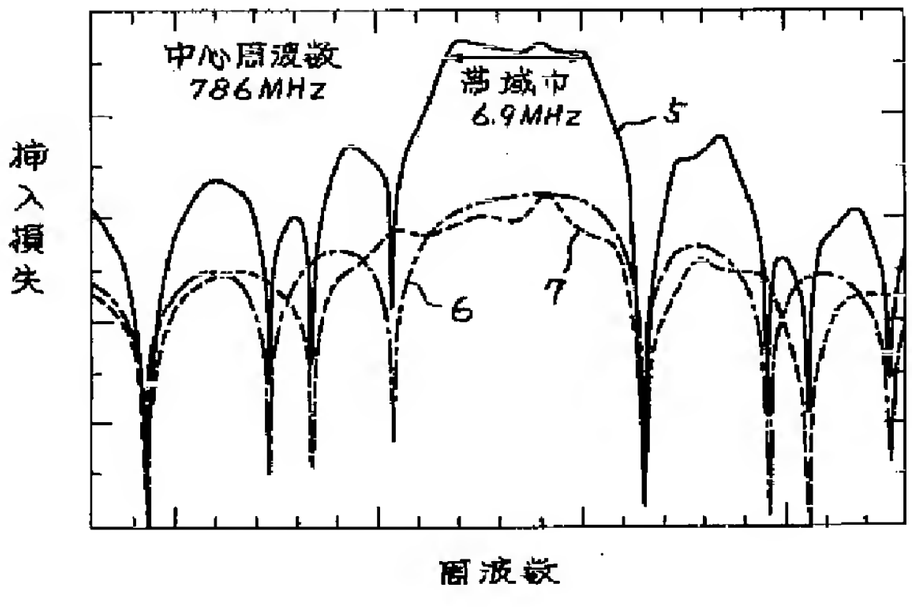
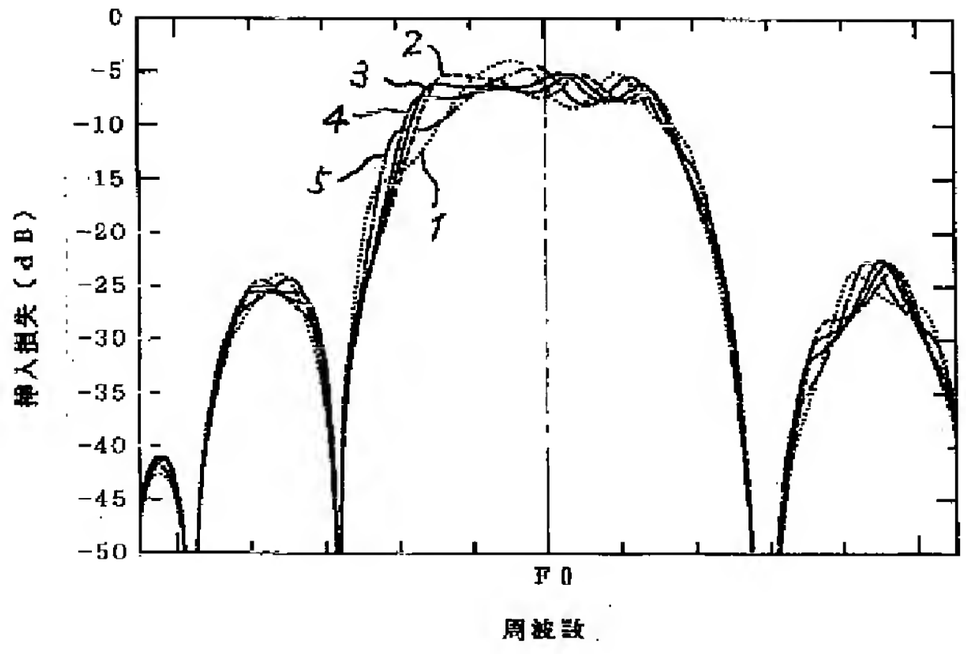


【図７】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-15
-20
-25
-30
-35
-40
-45
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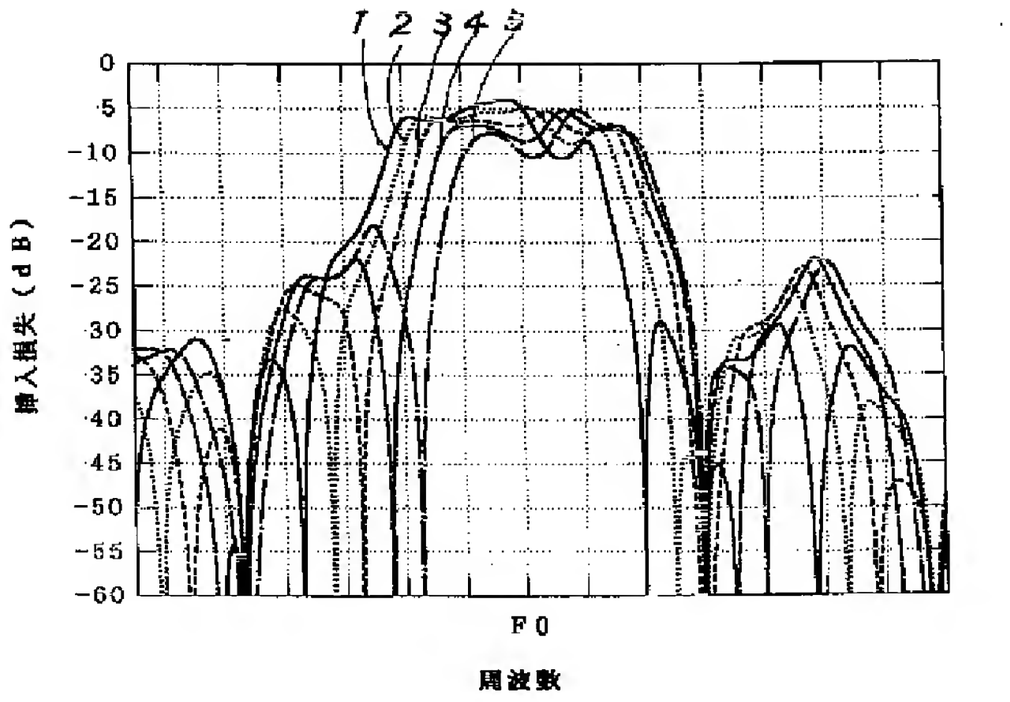
挿入損失（ｄＢ）
1
2
3
4
5
Ｆ０
周波数

【図８】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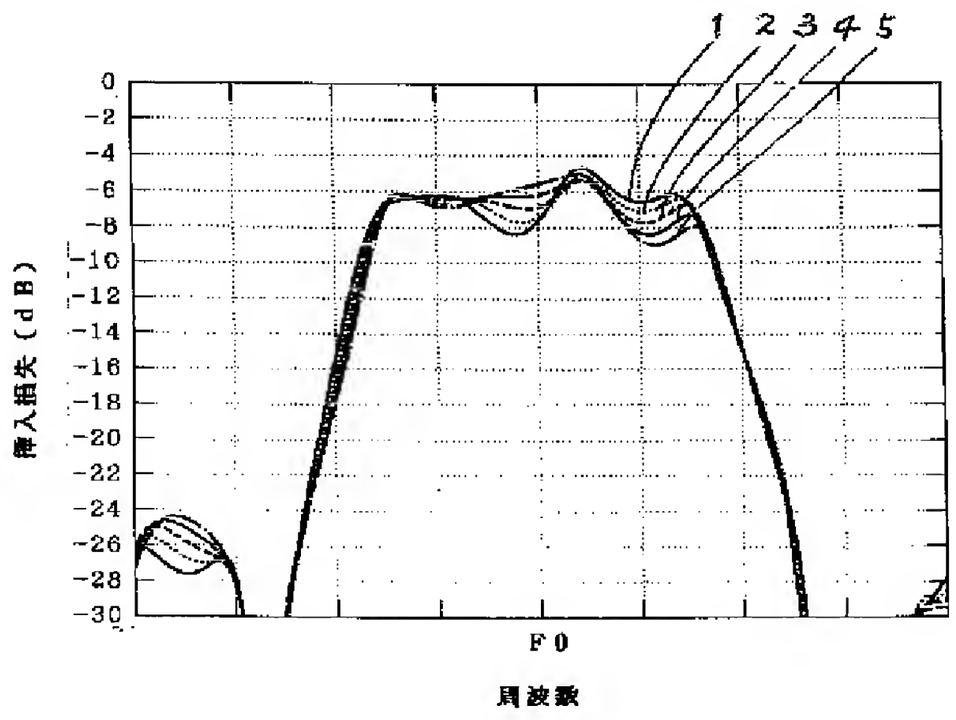
挿入損失（ｄＢ）
Ｆ０
周波数

【図９】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挿入損失（ｄＢ）
Ｆ０
周波数

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(71)Applicant :
SHOWA ELECTRIC WIRE & CABLE CO LTD
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(72)Inventor :
IZUMIYA HIROSHI
NOGUCHI KENJI
SANO KOJI

(54) RESONATOR SAW FILTER

(57)Abstract:
PROBLEM TO BE SOLVED: To reduce ripples furthermore by configuring electrode fingers of each electrode group to have different pitches so as to make a pass-band width broad and to improve the cut-off characteristic of the transition area.
SOLUTION: A conductor material is vapor-depositted to the surface of a substrate 10 and processed into interdigital electrodes by the method of the photolithography or the like to form respectively input electrodes 20 as a 1st electrode group, output electrodes 30 as a 2nd electrode group and reflecting electrodes 40 as a 3rd electrode group. One hundred and several tens of pairs of electrode fingers 21 are arranged to the input electrodes 20, about one hundred pairs of electrode fingers 31 are arranged to the output electrodes 30, and about several tens of pairs of electrode fingers 41 are arranged to the reflection electrodes 40 at a right angle to the lengthwise direction of the substrate 10 at pitches of nearly 1.046μm, 1.048μm, and 1μm respectively different from each other. The pitch for the input electrodes 20, the output electrodes 30 and the reflecting electrodes 40 is made different in this way, then a broad band characteristic is obtained and other characteristics are improved.

CLAIMS

[Claim(s)]
[Claim 1]In a resonator type SAW filter which allotted the 1st electrode group to a center section of the surface of a substrate which consists of piezoelectric material, allotted the 2nd electrode group to the both sides, and allotted the 3rd electrode group to both outsides of these 2nd electrode group, A resonator type SAW

filter considering a pitch of an electrode finger of each of said electrode group as different composition.
[Claim 2]The resonator type SAW filter according to claim 1, wherein multiple connection of the 2nd electrode group is carried out.
[Claim 3]The resonator type SAW filter according to claim 1 or 2, wherein the 1st electrode group and 2nd electrode group are split-electrodes structure.
[Claim 4]The resonator type SAW filter according to any one of claims 1 to 3 setting to 0.5xlambda - 0.6xlambda inter electrode distance L of the 1st electrode group and the 2nd electrode group that adjoins this when wavelength of center frequency of the 2nd electrode group is set to lambda.
[Claim 5]When based on pitch PA of an electrode finger of the 2nd electrode group, the pitch PB of an electrode finger of the 1st electrode group is set to "0.99616xPA - 0.99871xPA", And the resonator type SAW filter according to any one of claims 1 to 4 setting pitch PC of an electrode finger of the 3rd electrode group as "0.99234xPA - 0.99743xPA."

[Translation done.]
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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]In the resonator type SAW filter (surface acoustic wave filter) used by various kinds of apparatus for communication, insertion loss of this invention is small, and it relates to the resonator type SAW filter which made pass band width broadband-ize.
[0002]
[Description of the Prior Art]In various kinds of apparatus for communication, apparatus for measurement, etc. of a microwave band, the resonator type SAW filter using the elastic wave spread along the surface of piezoelectric material is used widely. Generally, resonator type SAW filters include A type SAW filter to which the input electrode and the output electrode have arranged two reflectors each on those outsides by one piece, and B type SAW filter to which the input electrode has arranged one piece and the output electrode has arranged two reflectors on those outsides by two pieces. Comparison of A type SAW filter and B type SAW filter knows that the B type of insertion loss is smaller and a carrier-to-noise ratio (C/N ratio) is good as a result. Since insertion loss will become large in proportion to it to broadband-ize pass band width if it does in this way although what is necessary is just to reduce the logarithm of the electrode finger in each electrode, it is not practical. Then, in A type SAW filter, as shown in JP,8-8690,A etc., the trial which attains broadband-ization is made by changing the electrode finger pitch of an input electrode and an output electrode.
[0003]Although this applicant for a patent had inquired per applying this art to small B type SAW filter of insertion loss, he was not able to acquire an expected band characteristic. Namely, drawing 2 is what shows the frequency characteristic of the insertion loss in B type SAW filter which used the solid electrode for the input electrode, the output electrode, and the reflector, The curve 1 shows the characteristic at the time of making equal all the electrode finger pitches of each electrode, and the curve 2 shows the characteristic at the time of changing the electrode finger pitch of an input electrode and an output electrode. In this case, as for the center frequency F0, the bandwidth W2 of 3.925 MHz and the curve 2 of the bandwidth W1 of 802 MHz and the curve 1 was 4.248 MHz. Thus, when the electrode finger pitch of an input electrode and an output electrode is changed, frequency

bandwidth spreads a little, but. The value was understood that it is small and filter characteristics including the transient region and pass band in a pass band are unsymmetrical focusing on the center frequency F0 at the low-pass (L) and high region (H) side. Therefore, it became clear that it was difficult to attain broadband-ization sufficient by having just changed the electrode finger pitch of an input electrode and an output electrode, and the flexibility of a design was low.
[0004]
[Problem(s) to be Solved by the Invention]The characteristic ideal as an SAW filter is as follows.
(1) Insertion loss be small and carry out [broadband]-izing.
(2) Filter characteristics including a transient region and a pass band be symmetrical focusing on the center frequency F0 at the low-pass and high region side.
(3) The waveform in a pass band should be a flat (there are few ripples).
(4) The flexibility of a design is large practical.
This invention makes it a technical problem to provide the resonator type SAW filter which fills such the characteristic.
[0005]
[Means for Solving the Problem]In a resonator type SAW filter which a resonator type SAW filter of this invention allotted the 1st electrode group to a center section of the surface of a substrate which consists of piezoelectric material, allotted the 2nd electrode group to the both sides, and allotted the 3rd electrode group to both outsides of these 2nd electrode group, A pitch of an electrode finger of each of said electrode group was considered as different composition.
[0006]
[Embodiment of the Invention]In this invention, various kinds of piezoelectric ceramic materials besides piezoelectric single crystal materials, such as crystal, lithium niobate, and lithium tantalate, are used as a substrate. Electrical conducting materials, such as aluminum metallurgy, are vapor-deposited on the surface of the substrate which consists of such piezoelectric material, etching processing of this is carried out to it using techniques, such as a photolithography, electron beam lithography, or X-ray lithography, and an input electrode, an output electrode, and a reflector are formed in it. To an input electrode, set the 2nd electrode group as an output electrode, set the 3rd electrode group as a reflector, respectively, and the 1st electrode group an input electrode and an output electrode, A large number can be made into the electrode finger of a book and the electrode structure (blind electrode) which connected them by turns every [every other (in the case of a solid electrode), or] (in the case of split electrodes) two which carried out parallel arrangement, respectively so that it might intersect perpendicularly with the direction of movement of a surface acoustic wave. The reflector can consist of short circuit electrodes which carried out parallel arrangement, respectively so that it might intersect perpendicularly with the direction of movement of a surface acoustic wave and which short-circuit many the electrode finger or each electrode fingers, and those both ends of a book. In these cases, the pitch, i.e., the linewidth, and space width of the electrode finger in each electrode of an input electrode, an output electrode, and a reflector can change a size for every electrode, and they are designed so that center frequency may differ. The pitch and center frequency of an electrode finger in two reflectors are designed equally.
[0007]In this invention, as shown in claim 2, by carrying out multiple connection of the 2nd electrode group, the surface acoustic wave spread on both sides from the 1st electrode group can be used effectively, and the insertion loss of an SAW filter can be reduced by half. In this case, the pitch (center frequency) of the electrode finger of the 2nd electrode group of being designed equally mutually is natural. In this invention, as shown in claim 3, the 1st electrode group and 2nd electrode group can be used as split electrodes, respectively. If it does in this way, the ripple component in a pass band can be decreased much more. If the inter electrode distance L of the 1st electrode group and the 2nd electrode group that adjoins these is set as 0.5xlambda - 0.6xlambda when wavelength of the center frequency of the 2nd electrode group is set to lambda as shown in claim 4, filter characteristics can be kept good much more. As shown in claim 5 again, when it is based on pitch PA of the electrode finger of the 2nd electrode group, If the pitch PB of the electrode finger of the 1st electrode group is set to "0.99616xPA - 0.99871xPA" and pitch PC of the

electrode finger of the 3rd electrode group is set as "0.99234xPA - 0.99743xPA", filter characteristics can be kept good much more.
[0008]
[Example]Hereafter, the example of this invention is described with reference to drawings. Drawing 1 is shown notionally and the example of the SAW filter of this invention in the surface of the substrates 10, such as crystal and lithium niobate. Vacuum deposition of the electrical conducting materials, such as aluminum metallurgy, is carried out, this is processed into a blind-like electrode with techniques, such as a photolithography, and the reflector 40 is formed as the output electrode 30 and the 3rd electrode group as the input electrode 20 and the 2nd electrode group as the 1st electrode group, respectively. The input electrode 20 formed in the center of the substrate 10 is the shape which arranged ten pairs of electrode fingers 21 at intervals of about pitch 1.046micrometer in the length direction of the substrate 10 in rectangular directions, and connected one end each of these electrode fingers 21 with either of the bus bar electrodes 22 and 23 by turns more than 100. Although the two output electrodes 30 set the interval L equal to the both sides of the input electrode 20 and are arranged, These output electrodes 30 are the shape which arranged about 100 pairs of electrode fingers 31 at intervals of about pitch 1.048micrometer in the length direction of the substrate 10 in rectangular directions, and connected one end each of these electrode fingers 31 with either of the bus bar electrodes 32 and 33 by turns, respectively.
[0009]Although the two reflectors 40 set an interval equal to the both sides of the output electrode 30 and are arranged, These reflectors 40 arrange the electrode finger 41 of about ten numbers at intervals of about pitch 1micrometer in the length direction of the substrate 1 in rectangular directions, short-circuit the both ends of these electrode fingers 41 with the short circuit electrodes 42 and 43, and are constituted, respectively. In the above, the pair of an electrode finger shall adjoin it with one electrode finger connected with one bus bar electrode, and shall call it a couple with one electrode finger connected with the bus bar electrode of another side, and the pitch of an electrode finger shall say the width of an electrode finger. As mentioned above, the SAW filter of this invention is changing mutually the pitch of the electrode finger of the input electrode 20, the output electrode 30, and the reflector 40.
Broadband-ization is attained by this and other characteristics are improving. Namely, drawing 3 so that clearly, if the characteristic in the above-mentioned example is shown and the curve 3, the curve 1, and the curve 2 (it is the same as the curve 1 in drawing 2 and the curve 2) in the figure are contrasted, In the case of the curve 3 (when the pitch of the electrode finger of the input electrode 20, the output electrode 30, and the reflector 40 is changed mutually), it is bandwidth W3. It is broadband-ized to 5.323 MHz.
The flexibility of the design is large.
The transient region B by the side of low-pass [as which filter characteristics including a transient region and a pass band were moreover regarded / as for the low-pass side / (L) and high region side / for (H) by becoming a symmetrical waveform mostly focusing on the center frequency F0 (802 MHz) in the case of the curve 1 or the curve 2] disappears, and its filter characteristics are improving.
[0010]By the way, a ripple remarkable in a pass band is seen in the example of drawing 1. Even if there is a ripple of this level, it is usable in many cases, but when it is requested that a ripple should be reduced more, as shown in drawing 4, it is good to use split electrodes as the input electrode 20 and the output electrode 30. As for the input electrode 20 formed in the center of the substrate 10, in this example, one end each of ten pairs of electrode fingers 21 is connected with either of the bus bar electrodes 22 and 23 by turns every two more than 100, The two output electrodes 30 which set the interval equal to the both sides of the input electrode 20, and have been arranged connect one end each of about 100 pairs of electrode fingers 31 with either of the bus bar electrodes 32 and 33 by turns every two, respectively, and are constituted. The two reflectors 40 which set the interval equal to the both sides of the output electrode 30, and have been arranged short-circuit the both ends of the electrode finger 41 of about ten numbers with the short circuit electrodes 42 and 43, respectively, and are constituted. These input electrodes 20, output electrodes 30, and reflectors 40 have changed the pitch of an electrode finger for every electrode. Incidentally, although the curve 4 in drawing 5 makes equal all the pitches of the electrode finger of the input electrode 20, the

output electrode 30, and the reflector 40 and the characteristic at the time of using split electrodes as the input electrode 20 and the output electrode 30 is shown, In this case, in order for the shoulder (A portion) by the side of the high frequency in a pass band to fall and to narrow bandwidth, about 5.4 MHz of bandwidth cannot be taken, but the transient region (B portion) by the side of a low frequency wave is also distorted, and an operating characteristic is not enough.
[0011]On the other hand, in the resonator type SAW filter which changed the pitch of the electrode finger for every electrode as mentioned above, and constituted the input electrode 20 and the output electrode 30 from split electrodes, As shown in the curve 5 of drawing 6, the ripple in a pass band was decreasing substantially, and the collapse by the side of a high region was lost, bandwidth is also expanded to 6.9 MHz, and the operating characteristic by the side of low-pass is also improved. The curve 6 in drawing 5 and drawing 6 shows the frequency characteristic of an input electrode, and the curve 7 shows the frequency characteristic by which the output electrode and the reflector were set. As mentioned above, according to this invention, pass band width broadband-izes, and the operating characteristic of a transient region is also improved and a ripple component can be decreased in a pass band. Like the above-mentioned example, when an output electrode or one input electrode has been arranged on each both sides of an input electrode or an output electrode, insertion loss can be reduced by half by carrying out multiple connection of them.
[0012]By the way, in the resonator type SAW filter shown in drawing 1 or drawing 4, since the pitches PB and PA of the electrode finger of the input electrode (the 1st electrode group) 20 and the output electrode (the 2nd electrode group) 30 differ, it depends for filter characteristics (output wave) on the inter electrode distance L of the input electrode 20 and the output electrode 30. Drawing 7 is what shows the characteristic at the time of changing the inter electrode distance L of the input electrode 20 and the output electrode 30 in the range of 0.3xlambda - 0.7xlambda to the wavelength lambda of pitch PA (center frequency) of the electrode finger of the output electrode 30, As for the curve 1, when the curve 2 is 0.5xlambda about the case of 0.3xlambda, the curve 3 shows the case of 0.55xlambda, the curve 4 shows the case of 0.6xlambda, and the curve 5 shows the case of 0.7xlambda. It can be judged that the characteristic at the time of 0.3xlambda of the curve 1 and 0.7xlambda of the curve 5 is a range whose characteristic of 0.4xlambda of the curves 2-4 - 0.6xlambda the ripple in a pass band is greatly unsuitable, and is preferred so that clearly from these curve groups.
[0013]Drawing 8 and drawing 9 are the characteristic figures at the time of changing electrode finger pitch PC of the pitch PB of the electrode finger of the input electrode 20, and the reflector 40 on the basis of electrode finger pitch PA of the output electrode 30 of the resonator type SAW filter shown in drawing 1 and drawing 4. The curves 1-5 of drawing 8 are what shows the characteristic at the time of changing the pitch PB of the electrode finger of the input electrode 20 in the range of "1xPA - 0.99488xPA" to electrode finger pitch PA of the output electrode 30, Although the curve 1 (1xPA) and the curve 5 (0.99488xPA) have a greatly unsuitable ripple in a pass band, the range of the curves 2-4 (0.99616xPA - 0.99871xPA) is understood that a ripple is small and preferred. The curves 1-5 of drawing 9 are what shows the characteristic at the time of changing pitch PC of the electrode finger of the reflector 40 in the range of "1xPA - 0.98982xPA" to electrode finger pitch PA of the output electrode 30, Although the curve 1 (1xPA) and the curve 5 (0.98982xPA) have a greatly unsuitable ripple in a pass band, the range of the curves 2-4 (0.99234xPA - 0.99743xPA) is understood that a ripple is small and preferred.
[0014]Although the above explanation was attached and stated to the example to which the center frequency of the input electrode and the antenna reflector was made to increase a little to the center frequency of an output electrode, As for this invention, it is needless to say that it is not limited to this, and the center frequency of an input electrode and an antenna reflector may be decreased to an output electrode, and the width of those increase and decrease is not limited to an above-mentioned example, either. In this invention, even if it replaces the input electrode and output electrode in each example, the same characteristic can be obtained.
[0015]
[Effect of the Invention]As mentioned above, according to this invention, pass band

width broadband-izes, and the operating characteristic of a transient region is also improved and a ripple component can be decreased in a pass band.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The explanatory view showing notionally the example of the resonator type SAW filter of this invention.
[Drawing 2]The graph which illustrates the frequency characteristic of the insertion loss in the conventional resonator type SAW filter.
[Drawing 3]The graph which illustrates the frequency characteristic of the insertion loss in the resonator type SAW filter of drawing 1.
[Drawing 4]The explanatory view showing notionally other examples of the resonator type SAW filter of this invention.
[Drawing 5]The graph which illustrates the frequency characteristic of the insertion loss at the time of adopting split electrodes as an input electrode and an output electrode in the conventional resonator type SAW filter.
[Drawing 6]The graph which illustrates the frequency characteristic of the insertion loss of the resonator type SAW filter of drawing 4.
[Drawing 7]The graph which illustrates the frequency characteristic of the insertion loss at the time of changing the inter electrode distance L of an input electrode and an output electrode in a resonator type SAW filter.
[Drawing 8]The graph which illustrates the frequency characteristic of the insertion loss at the time of changing the pitch PB of the electrode finger of an input electrode to electrode finger pitch PA of an output electrode in a resonator type SAW filter.
[Drawing 9]The graph which illustrates the frequency characteristic of the insertion loss at the time of changing pitch PC of the electrode finger of a reflector to electrode finger pitch PA of an output electrode in a resonator type SAW filter.
[Description of Notations]
10 .... Substrate
20 .... Input electrode
30 .... Output electrode
40 .... Reflector
21, 31, 41 .... Electrode finger
22, 23, 32, 33 .... Bus bar electrode
42, 43 .... Short circuit electrode

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DRAWINGS

[Drawing 1]

[Drawing 2]

[Drawing 3]

[Drawing 4]

[Drawing 5]

[Drawing 6]

[Drawing 7]

[Drawing 8]

[Drawing 9]

[Translation done.]